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(54) **PRINTED CIRCUIT BOARD STRUCTURE**

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G01R 31/00	(2006.01)
G01R 31/20	(2006.01)
H05K 1/02	(2006.01)

(52) **U.S. Cl.**

CPC ***H05K 1/02*** (2013.01)

(58) **Field of Classification Search**

CPC H05K 1/02

USPC 174/250; 324/756.01, 756.03, 757.02, 324/757.03

See application file for complete search history.

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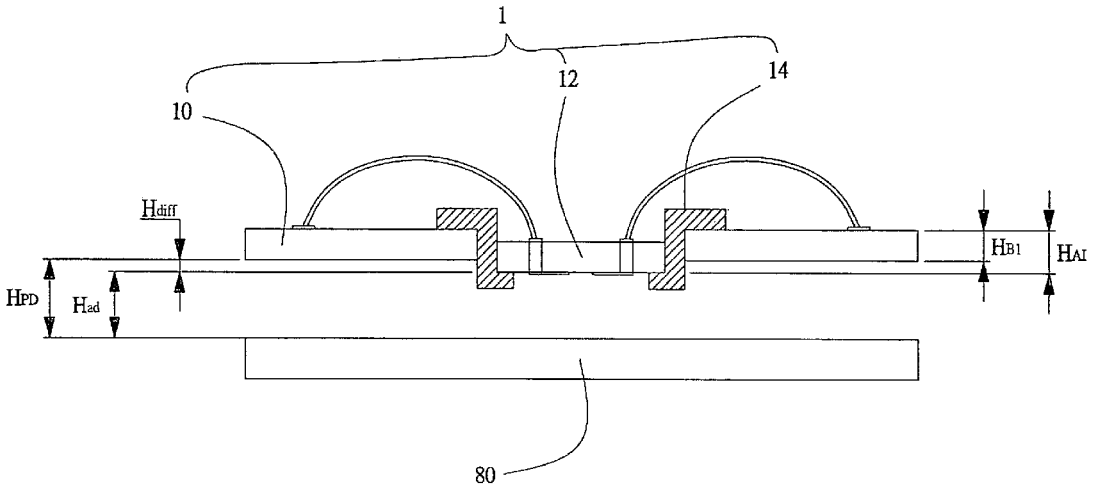
(57) **ABSTRACT**

The invention relates to a printed circuit board structure, which comprises a first body, a second body and a sleeve. The sleeve is arranged between and connected with the first body and the second body so as to generate a differential height between the first body and the second body. Via the differential height are solved the problems of insufficient probe stiffness and poor wafer-sort quality, which is caused by decreasing the probe diameter to adapt to miniaturized chips.

10 Claims, 5 Drawing Sheets



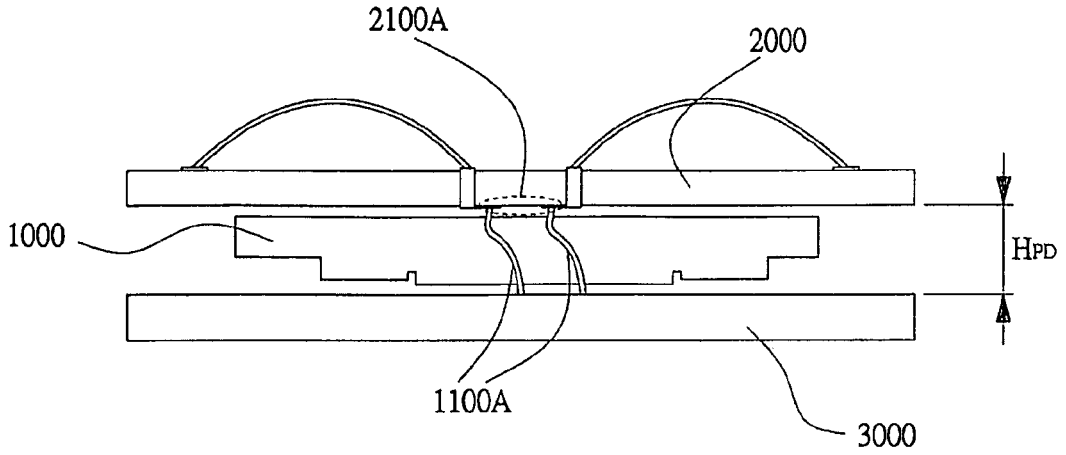

2100A
2000
1000
HPD
1100A
3000

Fig.1A

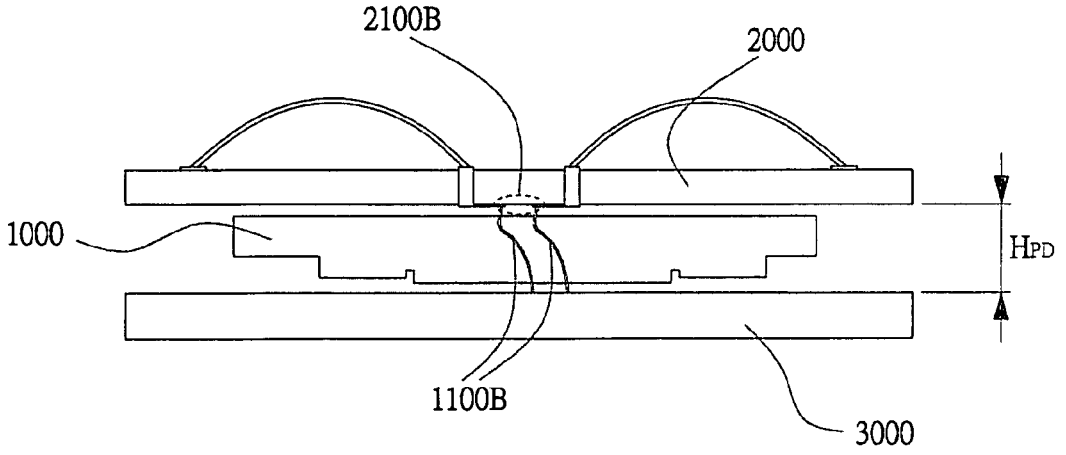

2100B
2000
1000
HPD
1100B
3000

Fig.1B

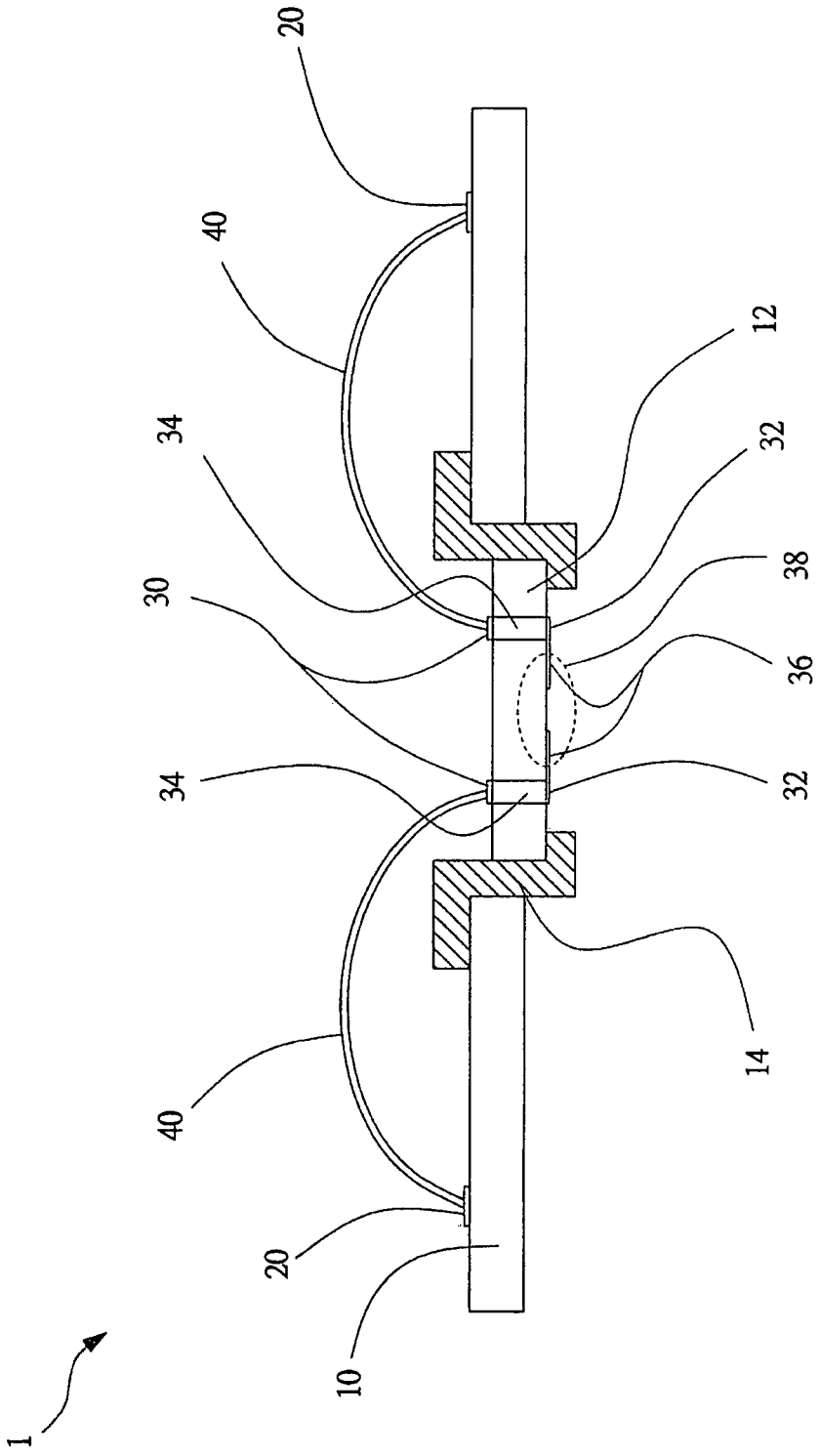


Fig.2

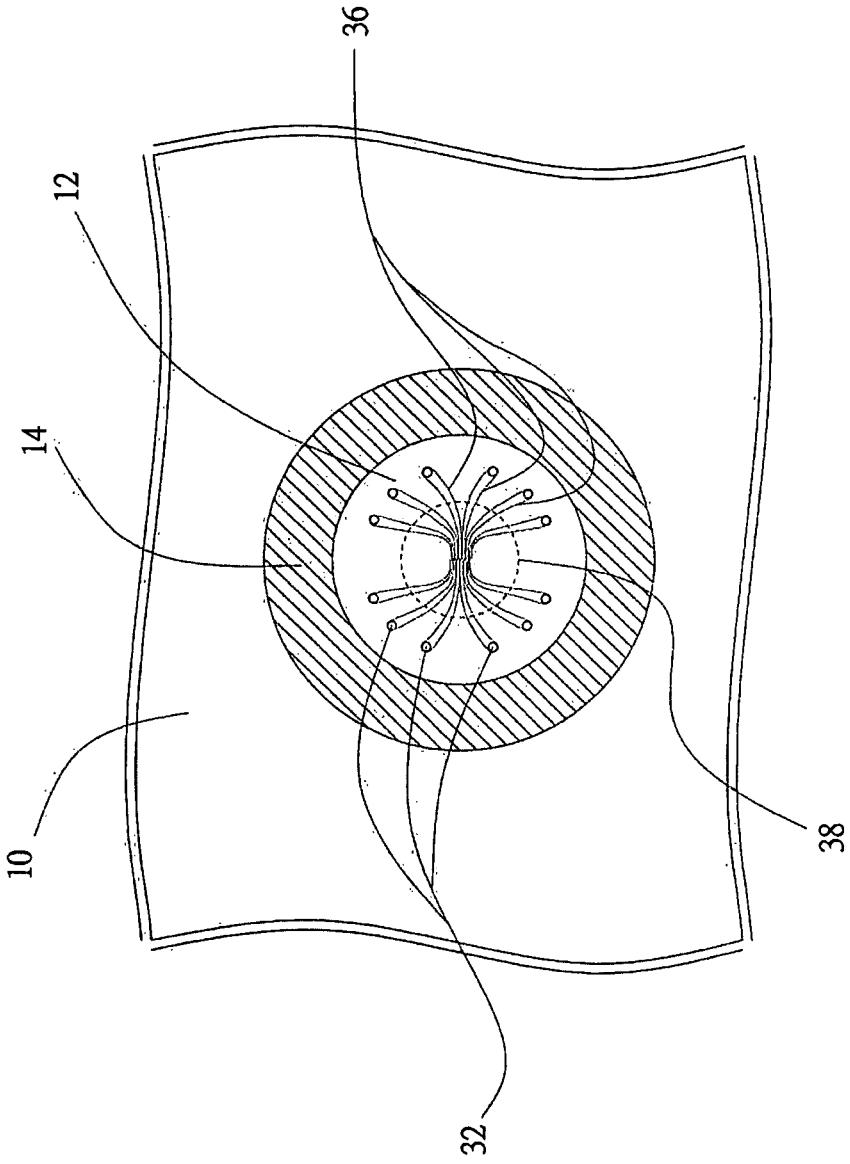
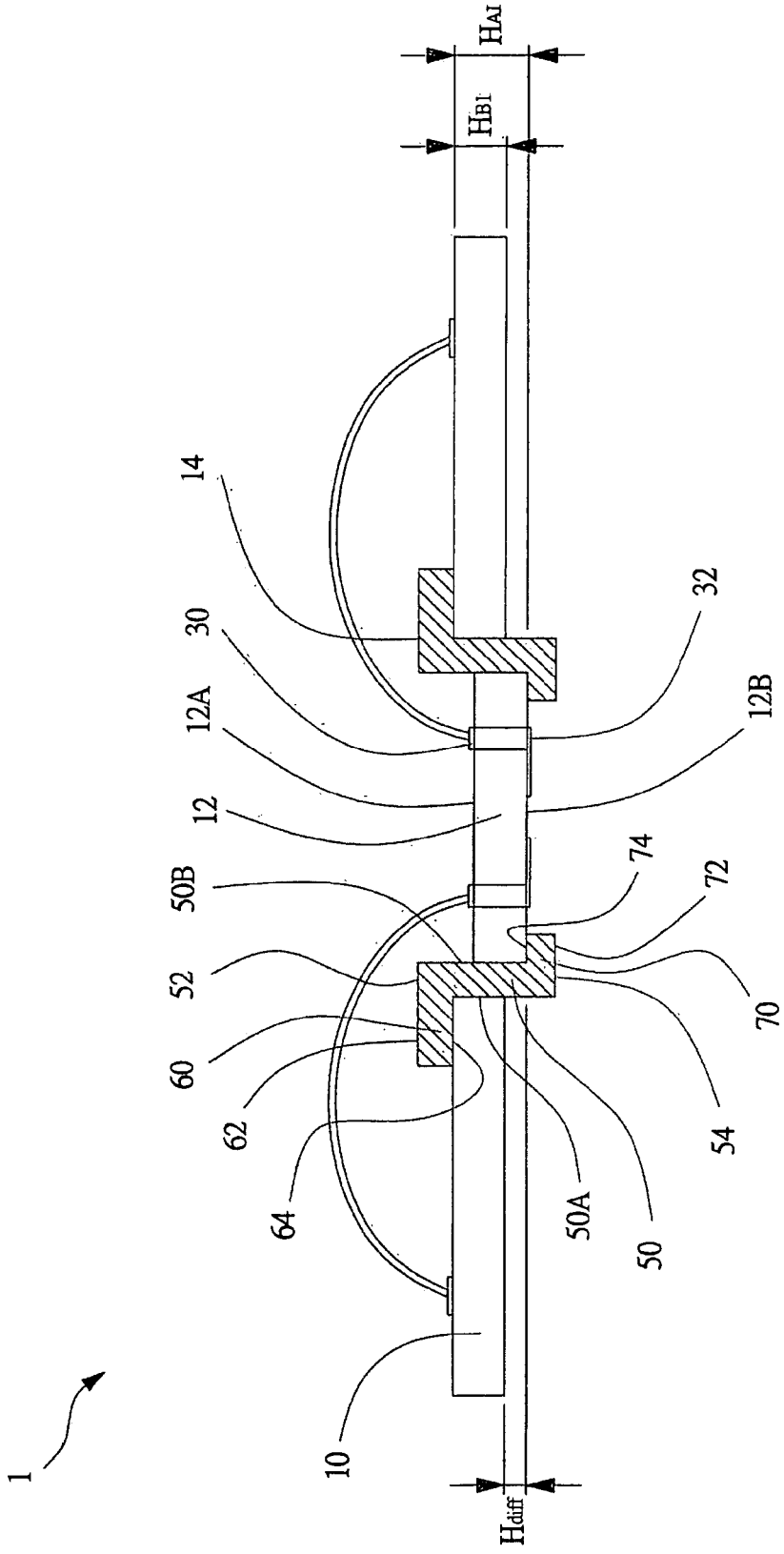


Fig.3


HA1
HB1
14
30
12A
12
50B
52
60
62
64
10
1
32
12B
74
72
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54
50A
50
Hdiff

Fig.4

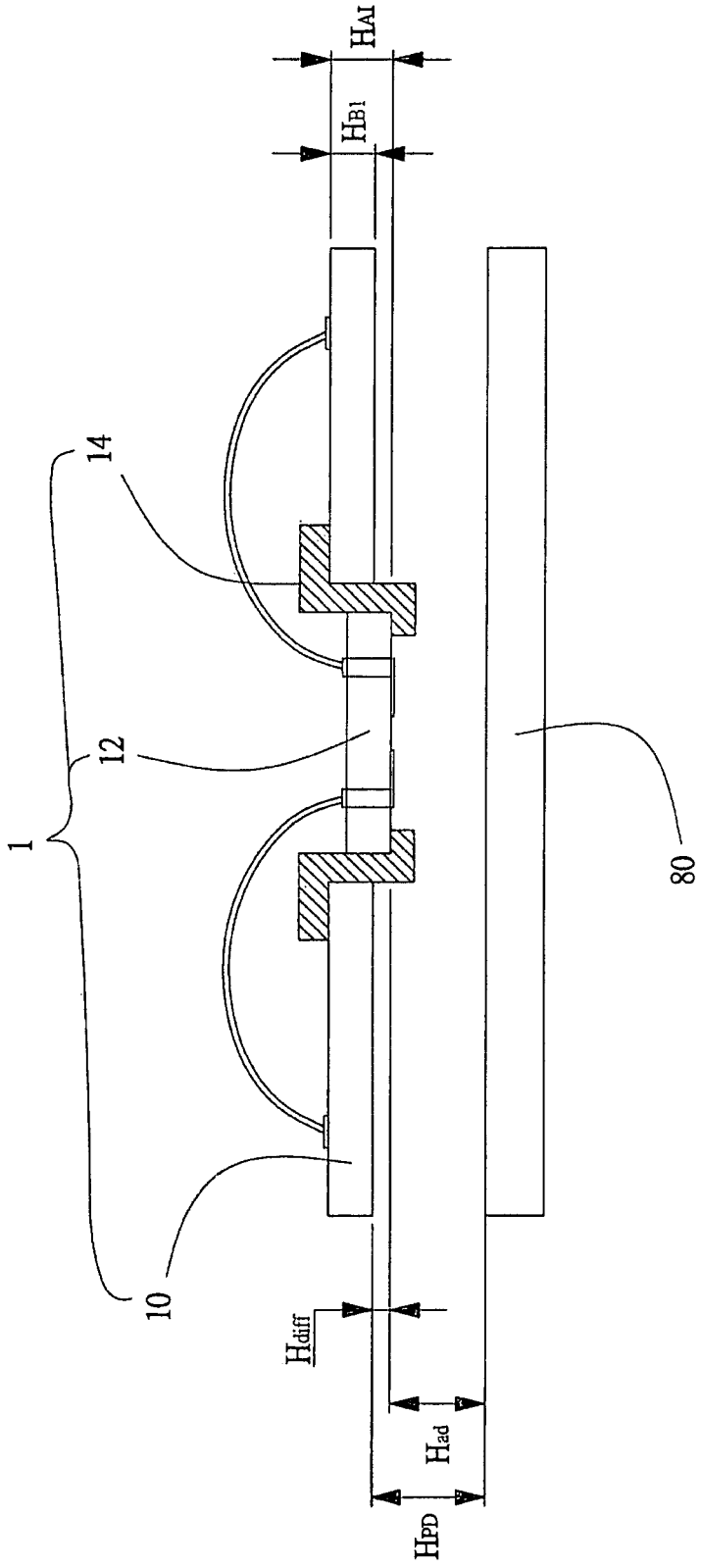

Fig.5

PRINTED CIRCUIT BOARD STRUCTURE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an IC test device, particularly to an assembling type printed circuit board structure of a probe card.

2. Description of the Prior Art

In semiconductor fabrication, wafer sort is referred to a technology testing the integrated circuit (IC) on a wafer to guarantee that IC can operate normally and learn the yield of products. Normally, an automatic test equipment (ATE) is temporarily electrically connected with IC on a wafer to verify the performance of IC. A probe card is used to transmit signals between ATE and IC.

Refer to FIG. **1**A. In a conventional wafer sort, probes **1100**A of a probe card **1000** are interposed between and connected with a printed circuit board **2000** and a tested wafer **3000**, which are separated from each other by a predefined/fixed probe depth H_{PD}. The probe **1100**A has a specified diameter-to-length ratio so as to maintain the stiffness of the probe **1100**A and favor the connection of the probe **1100**A to the printed circuit board **2000** and the wafer **3000**. With continuous advancement of semiconductor technology, chips are persistently miniaturized to smaller and smaller size. Therefore, it is necessary to reduce the related dimensions of a probe card for wafer sort. Refer to FIG. **1**B. The size and spacing of electrodes in the testing area **2100**B in the wafer side of the printed circuit board **2000** in FIG. **1**B are smaller than the size and spacing of electrodes in the testing area **2100**A in the wafer side of the printed circuit board **2000** in FIG. **1**A. Thus, the diameter of the probe **1100**A in FIG. **1**A must be reduced to the diameter of the probe **1100**B in FIG. **1**B so as to meet the new situation. In the case that the probe depth H_{PD} and the dimensions of the probe card are unchanged, the diameter-to-length ratio of the probes **1100**B must be reduced, which will further reduce the stiffness of the probes **1100**B and affect the connection of the probes **1100**B to the printed circuit board **2000** and the wafer **3000**. Thus, the quality and result of wafer sort is also affected.

SUMMARY OF THE INVENTION

One objective of the present invention is to provide a printed circuit board (PCB) structure, which has a two-stage printed circuit board and various sizes of sleeves for adjusting the distance between the wafer and the specified area of the printed circuit board, whereby to shorten the length of the probes appearing between the wafer and the specified area of the printed circuit board, and whereby to maintain the diameter-to-length ratio of the probes within a specified range, wherefore the problem of insufficient probe stiffness is overcome, and wherefore the printed circuit board structure of the present invention can meet the tendency of dimensional reduction in wafer sort and undertake wafer sort in high efficiency, high adaptability and high precision.

In one embodiment, the printed circuit board structure of the present invention comprises a sleeve, a first body and a second body. The sleeve includes a wall, a first protrusion and a second protrusion. The wall extends along an axial direction, has an outer wall surface and an inner wall surface in a radial direction, and has a first wall end and a second wall end opposite the first wall end in the axial direction. The first protrusion extends outward radially from the first wall end and defines a first outer side and a first inner side opposite the first outer side in the axial direction. The second protrusion extends inward radially from the second wall end and defines a second outer side and a second inner side opposite the second outer side in the axial direction. The first body is detachably connected with the first inner side. The second body is detachably connected with the second inner side. The first inner side and the second inner side define a sleeve inner side height, which is greater than a first body thickness of the first body.

Preferably, the printed circuit board structure of the present invention comprises a wafer. The first body and the wafer define a predefined probe depth. The second body and the wafer define an adjustment depth. The predefined probe depth is greater than the adjustment depth.

In another embodiment, the printed circuit board structure is arranged over a wafer for wafer sort and comprises a sleeve, a first body and a second body. The sleeve includes a wall. The wall extends along an axial direction and has an outer wall surface and an inner wall surface in a radial direction. The first body is disposed in the outer wall surface of the sleeve. The second body is disposed in the inner wall surface of the sleeve. The first body and the wafer define a predefined probe depth. The second body and the wafer define an adjustment depth. The predefined probe depth is greater than the adjustment depth.

Below, embodiments are described in detail in cooperation with the attached drawings to make easily understood the objectives, technical contents, characteristics and accomplishments of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A is a sectional view schematically showing that the probes of a probe card are connected with a printed circuit board and a wafer in a conventional wafer sort;

FIG. **1**B is a sectional view schematically showing that the probes have a smaller diameter than the probes in FIG. **1**A;

FIG. **2** is a sectional view schematically showing a printed circuit board structure according to one embodiment of the present invention;

FIG. **3** is a local bottom view schematically showing a printed circuit board structure according to one embodiment of the present invention;

FIG. **4** is a sectional view where numerals are assigned to the components of the sleeve shown in FIG. **2** and characteristic dimensions are defined;

FIG. **5** is a sectional view schematically showing the configuration of a printed circuit board structure and a tested wafer/semiconductor device according to one embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Refer to FIG. **2** a sectional view schematically showing a PCB structure according to one embodiment of the present invention. The PCB structure **1** of the present invention comprises a first body **10**, a second body **12** and a sleeve/adapter **14**. In substance, the sleeve **14** is a hollow column or hollow disc where a through hole penetrates. The sleeve **14** is disposed between the first body **10** and the second body **12** and separates the first body **10** from the second body **12**. In detail, the first body **10** is detachably connected with the outer surface of the sleeve **14** (disposed outside the through hole); the second body **12** is detachably connected with the inner surface of the sleeve **14** (disposed inside the through hole). Preferably, the first body **10** has a plurality of first electrodes **20**, and the second body **12** has a plurality of second elec-

trodes **30** respectively corresponding to the first electrodes **20**. Preferably, a wire **40** is disposed between each of the first electrodes **20** and the corresponding one of the second electrodes **30**, electrically connecting the first electrode **20** with the corresponding second electrode **30**. Preferably, each of the second electrodes **30** has a corresponding third electrode **32** disposed on the second body **12**. Preferably, a plated through hole **34** is formed between each second electrode **30** and the corresponding third electrode **32**, penetrating through the second body **12** and electrically connecting the second electrode **30** and the corresponding third electrode **32**. Refer to FIG. **2** again and refer to FIG. **3**. Preferably, each of the third electrodes **32** has a signal trace **36**; the signal trace **36** gradually shrinks in width and extends to a specified/test area **38** where the signal traces **36** contact probes of a probe card (not shown in the drawing). It should be noted: FIG. **3** is not to limit but only to exemplify the quantities and layout of the third electrodes **32** and the signal traces **36**.

In one embodiment, the second body **12** has at least one electric barrier (not shown in the drawing) disposed between each two adjacent signal traces **36**, especially among the rear ends of at least two signal traces **36**. The electric barrier has a higher insulation coefficient, such as an insulation coefficient equal to or higher than the insulation coefficient of air, so as to reduce the probability of current leakage between two adjacent signal traces **36**. Preferably, the electric barrier is in form of at least one of slots, holes and structures made of an insulating material; the slots are through slots or blind slots; the holes are through holes or blind holes; the insulating material has an insulation coefficient higher than the insulation coefficient of air.

Refer to FIG. **4** for the detailed structure of the sleeve **14**. The sleeve **14** includes a wall **50**, a first protrusion **60** and a second protrusion **70**. The wall **50** extends axially, having an outer wall surface **50**A and an inner wall surface **50**B in the radial direction and having a first wall end **52** and a second wall end **54** opposite the first wall end **52** in the axial direction. The first protrusion **60** extends outward radially from the first wall end **52** and defines a first outer side **62** and a first inner side **64** opposite the first outer side **62** in the axial direction. The second protrusion **70** extends inward radially from the second wall end **54** and defines a second outer side **72** and a second inner side **74** opposite the second outer side **72** in the axial direction. The first body **10** is disposed in the outer wall surface **50**A of the sleeve **14**. Preferably, the first body **10** is detachably connected with the first protrusion **60** of the sleeve **14**. In one embodiment, the first body **10** is detachably connected with the first inner side **64** of the first protrusion **60** of the sleeve **14**. The second body **12** is disposed in the inner wall surface **50**B of the sleeve **14**. Preferably, the second body **12** is detachably connected with the second protrusion **70** of the sleeve **14**. In one embodiment, the second body **12** is detachably connected with the second inner side **74** of the second protrusion **70** of the sleeve **14**. The abovementioned structure defines a sleeve inner side height H_{A1} between the first inner side **64** and the second inner side **74**, which is greater than the first body thickness H_{B1} of the first body **10**. Thus, a differential height H_{diff} exists between the second inner side **74** and one side of the first body **10**, which is near the second inner side **74**. In other words, the differential height H_{diff} exists between one side of the second body **12**, which contacts the second inner side **74**, and one side of the first body **10**, which is near the second inner side **74**. The configuration of the second electrodes **30** and the third electrodes **32** in the second body **12** is further described in detail below. The second electrodes **30** are disposed on one side **12**A of the second body **12**, which is far away from the second protrusion **70**. The third electrodes **32** are disposed on another side **12**B of the second body **12**, which is near the second protrusion **70**, and correspond to the second electrodes **30**.

Refer to FIG. **5** a diagram schematically showing the configuration of a PCB structure and a tested wafer/semiconductor device according to one embodiment of the present invention. The PCB structure **1** is disposed over a wafer **80** for wafer sort. The differential height H_{diff} of the sleeve inner side height H_{A1} and the first body thickness H_{B1} makes the adjustment height H_{ad}, which is defined by the second body **12** and the wafer **80**, smaller than a predefined probe depth H_{PD}, which is defined by the first body **10** and the wafer **80**. While chip miniaturization demands that the diameter of the probes should be reduced, the distance between the second body **12** and the wafer **80** that are connected by the probes of the probe card (not shown in the drawing), especially the probe length at which the probes connect the second body **12** and the wafer **80**, can be reduced without varying the predefined grip length/predefined probe depth H_{PD} between the PCB structure **1** (especially the first body **10**) and the wafer **80** because of the abovementioned configuration. Thereby, the diameter-to-length ratio of the probes exposed from the probe card can be maintained within a specified range.

What is claimed is:

1. A printed circuit board structure comprising:

a sleeve including

a wall extending along an axial direction, having an outer wall surface and an inner wall surface in a radial direction, and having a first wall end and a second wall end opposite said first wall end in said axial direction;

a first protrusion extending outward radially from said first wall end and defining a first outer side and a first inner side opposite said first outer side in said axial direction; and

a second protrusion extending inward radially from said second wall end and defining a second outer side and a second inner side opposite said second outer side in said axial direction;

a first body detachably connected with said first inner side; and

a second body detachably connected with said second inner side,

wherein said first inner side and said second inner side define a sleeve inner side height, which is greater than a first body thickness of said first body.

2. The printed circuit board structure according to claim **1**, wherein said first body has a plurality of first electrodes; said second body has a plurality of second electrodes respectively corresponding to said first electrodes; and a wire is disposed between each said first electrode and one said second electrode corresponding to said first electrode.

3. The printed circuit board structure according to claim **2**, wherein said second electrodes are disposed on one side of said second body, which is far away from said second protrusion; another side of said second body, which is near said second protrusion, has a plurality of third electrodes respectively corresponding to said second electrodes; wherein said second body has a plurality of plated through holes electrically connecting said second electrodes with said third electrodes.

4. The printed circuit board structure according to claim **3**, wherein each of said third electrodes has a signal trace extending to a specified area with a width thereof gradually shrinking.

5. The printed circuit board structure according to claim 4, wherein at least one electric barrier is disposed among at least two said signal traces.

6. The printed circuit board structure according to claim 1 further comprising a wafer, wherein said first body and said wafer define a predefined probe depth, and wherein said second body and said wafer define an adjustment depth, and wherein said predefined probe depth is greater than said adjustment depth.

7. A printed circuit board structure arranged over a wafer for wafer sort and comprising

a sleeve including a wall extending along an axial direction and having an outer wall surface and an inner wall surface in a radial direction;

a first body disposed in said outer wall surface of said sleeve; and

a second body disposed in said inner wall surface of said sleeve,

wherein said first body and said wafer define a predefined probe depth, and said second body and said wafer define an adjustment depth, and wherein said predefined probe depth is greater than said adjustment depth.

8. The printed circuit board structure according to claim 7, wherein said wall has a first wall end and a second wall end opposite said first wall end in said axial direction; and said wall has a first protrusion extending outward radially from said first wall end and a second protrusion extending inward radially from said second wall end.

9. The printed circuit board structure according to claim 8, wherein said first protrusion of said sleeve detachably rests on said first body, and said second body detachably rests on said second protrusion of said sleeve.

10. The printed circuit board structure according to claim 7, wherein said second body has at least one electric barrier.

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